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Reactor Operations, Inspection and Maintenance

PNGS CALIBRATION PROGRAM

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1.0 Introduction:

The PNGS Calibration Program is being implemented as a response to various concerns identified in recent PEER Evaluations and AECB audits. Identified areas of concern were the approach to instrument calibration and the performance monitoring of the calibration of Special Safety Systems (SSS). The implementation of a Calibration Program is a significant improvement in operating practices. A systematic and comprehensive approach to calibration of instrumentation will improve the quality of operation of the plant with a positive contribution to PNGS safety of operation and economic objectives. The program being implemented will reflect succesful programs used in the industry and those recommended in the Instrument Society of Measurement and Control (ISA)/Electric Power Research Institute (EPRI) methodologies. Successful program implementation is essential to support surveillance and monitoring requirements.

The PNGS Governing Policy on systems surveillance and performance monitoring requires (SRP 3.10):

a) providing assurance that equipment needed for safe and reliable operation will perform reliably and within required limits;

b) performance monitoring activities optimize plant reliability and efficiency;

The calibration program being implemented at PNGS addresses the following concerns:

a) Ensure that instrumentation calibration is within the specified limits.

b) Develop a methodology and establish a frequency of calibration to provide confidence that systems operate

within safe parameters.

c) Improve the quality of the plant operation.

d) Satisfy OHN Performance Objectives and Criteria in the area of Technical Support, Maintenance and Operations.

This paper describes the strategy to implement the proposed calibration program and describes its calibration data requirements.

2.0 Challenge:

PND's commitment to Nuclear Excellence in all aspects of nuclear Operation has translated into the adoption and implementation of good operating practices as recommended by recognized international standards. The calibration program is one of the good operating practices used to improve the Quality of Operation of PNGS.

3.0 Vision

The benefits of the Calibration Program for the safe operation and efficient maintenance of PND are as follows:

- Special Safety System (SSS) trip parameter instrument loops have a full set of verified calibration specification sheets and procedures for calibration activities.

- All Safety and Safety-Related Process System instrument loops which have a significant impact upon station KRA's (key result areas) are calibrated at an appropriate frequency .

- A methodology and procedure to support the system surveillance program, to track, to optimize calibration activities, and to monitor loop parameters.

- A methodology and procedures to review "as found" and "as left" calibration data in a software package suitable for use by the System Responsible Engineer (SRE), and Design Responsible Engineers (DRE's).

4.0 Strategy

4.1 Outline

The plan adopted to translate the Challenge into an improved Calibration Program, is a strategy consisting of several phases. The objectives of each phase of this strategy are outlined below:

Preliminary Work (all PNGS systems):

Review calibration data and calibration processes in place.

- The systems selected and their priority of implementation is based on the contribution of each station system to Reactor Safety, Licensing and Key Result Areas for the station.

- Define the scope and sources of all the data required by the different phases of the Calibration Program.

- Develop an implementation strategy.

-Implement a pilot program to test on selected systems the feasibility of the approach developed.

Phase 1: Basic Program

- Review of all instrumentation loops to identify deficiencies in current calibration practices.

- Produce a database documenting the current status of the calibration practices for each system.

Phase 2: Complete calibration specifications.

- For each analyzed instrument and corresponding instrument loop, perform a technical analysis of the calibration tolerances, calibration frequency and calibration drift and an error analysis for the current calibration practices (SSS).

- Generate and update calibration call-ups and maintenance procedures in a systematic and consistent fashion (SSS and Process Systems).

- Produce a database documenting the results of reviewing and analyzing each instrument and each loop calibration (As required).

Phase 3: Field implementation into the practical plant environment.

- Generate reliable data for a calibration database with "As found/As left" calibration data.

- Incorporation by the SRE to the Technical Surveillance Monitoring.

4.2 Preliminary Work

The Management of Engineering Services at PND recognized the need to improve and expand the existing station calibration program. The previous calibration practices were considered as not satifying the station needs. It was widely assumed that the absence of a systematic approach to calibration had contributed to unplanned equipment unavailability, innefficient use of resources, and loss of revenue.

A review of different station systems indicated that there was calibration data and calibration processes in place for some station systems, notably the Protective System(s); however, a thorough review and documentation of what existed in the field had never been completed. Calibration data and calibration processes for some systems was incomplete and a few systems did not have any. Calibration and maintenance was being done on a non-systematic basis. This was the basic premise to initiate the PND Calibration Program.

The initial actions were:

a) review and evaluate all existing calibration data in place within Engineering Services and the field.

b) establish design guidelines regarding system I & C calibration requirements.

c) compare existing calibration programs at the station.

The result of these initial actions was the proposed model of the calibration program and a strategy for its implementation. This strategy will then be tested on a pilot project, as described below.

Considerable effort and research time was spent defining and scoping the data required (not necessarily the data available) to develop an effective calibration program. As a result all the required data sources were identified. Since most of the data was retrieved manually, a procedural mechanism to retrieve the data from the current information available in the plant was developed to ensure completeness.

The strategy was tested via a pilot project to complete the calibration program requirements for some PNGS-A ECI and Containment loops. The existing calibration program for the Protective System was chosen as the framework of the model to follow. This framework combined with the experience from the calibration programs in place for the Protective, ECI and Containment systems was also used to determine the feasibility of the proposed approach and its capability to satisfy the station needs.

4.3 Phase 1: Basic Program

The objective of this phase is to identify the current calibration status and to produce a database with accurate and salient information. The need satisfied by this objective is to ensure completeness of calibration information.

A systematic review of the prioritized instrumentation loops produces a summary of the calibration and maintenance program for each system as per established priorities.

In a systematic fashion, and using the data sources described in the following section, a database of all instruments for a given system is produced. This methodology ensures that all sources of information are documented and gaps and deficiencies identified (i.e."gap analysis").

The information produced by the Basic Program gives the SRE the status of each instrument and each loop. A database is produced which identifies:

a) routine testing of the instrument or instrument loop. If the instrument or instrument loop is safety related, it identifies which licensing test(s) are performed;

b) routine maintenance call-ups in place and frequency at which they are performed

c) maintenance procedures available;

d) calibration specifications and calibration information available;

e) manufacturer data available;

f) availability of spares (SSS only);

g) completeness of documentation sources and other miscellaneous comments and observations identified by this process.

The information thus gathered is used by the System Responsible

Engineers (SRE) to initiate the appropriate action. The information generated allows the SRE to "fill the gaps"; i.e. update calibration sheets, generate maintenance call-ups, provide maintenance procedures, etc..

4.4 Phase 2: Complete calibration specifications.

This Phase involves completing the database prepared in Phase 1 to include complete calibration specifications for instruments loops and controls associated with trip parameters and which directly impact upon OP&P limits or have a significant economic impact. This phase generates outstanding maintenance call-ups and reviews Maintenance Procedures, updates Calibration Sheets to include generic instrument tolerances, etc.

The results of the loop error analysis and the loop uncertainty, instrument drift error, and loop error tolerance are compared with the tolerance derived from Design requirements. Any discrepancies are noted for possible corrective action and/or further analysis.

This information is presented in the form of a database with all the calibration requirements. This database will be used by the SRE as part of the Technical Surveillance and Monitoring activities (described in Phase 3).

This loop error analysis provides a System Performance Standard. The SRE/DRE can monitor the deviation from desired performance to detect degradation of a loop, or, identify improvements to current maintenance and operational practices. The performance or the health of systems can be monitored to have reasonable assurance that the instrument/loop/system in question is capable of performing its intended function. The SRE then can trend system parameters important to determine the health of the system.

The PNGS Calibration Program is a technical surveillance tool which ensures that system instrumentation is within the specified design limits; provides a basis, a method, and a frequency of calibration to ensure that system operation is within those limits, and improves the quality of operation of the plant. At the end of this phase of the calibration program, the required technical data gathering is complete. The the next step is to implement this program in the practical plant environment.

4.5 Phase 3: Field implementation.

Several initiatives are under way to incorporate the calibration program into the plant environment:

- A computerized Calibration Information System is being developed. This system will provide historical calibration data as well as the tolerances and other relevant information. The implementation of the capability of performing the analysis of As found/as left data, as well as other features, are under consideration.

- PNGS implementation of Technical Surveillance programs.

- The participation of the SRE/DRE's in developing the calibration program for systems under their responsibility.

5.0 DATA REQUIREMENTS

5.1 General Requirements:

The following are the data requirements for the succesful implementation of the calibration program:

a) For each system (USI), a complete and comprehensive list of all instruments loops.

b) For each instrument loop, a complete and comprehensive list of all the instruments of the loop.

c) For each instrument, the following data is required:

- System Description.
- Equipment Code .
- System designation (USI).
- Make and Model of the instrument. PNGS Stock Code.
- Routine Test(s) which require the instrument.
- Reference drawings.
- Maintenance procedures.
- Routine maintenance call-ups.
- Frequency of calibration.
- Set Points:
  - Licensing or Process trip setpoint(s);
  - Licensing or Process Operating limit(s);
  - Trip Sepoint (TSP) tolerance.

- Calibration specifications and calibration tolerances (5 points minimum), Required accuracy and suppression.
- Maintenance & Test equipment (MTE): make and model, scale to use and reference accuracy. Input & output tolerances. Target output uncertainty.
- Availabilty of spares in stock (SSS systems)
- Comments and feedback from the field (if available)

5.2 Sources of calibration data

The main sources of information, listed in their perceived order of quality, were the following:

a) Station generated documentation, information to be considered of the highest quality since the information is, or can be verified:

- Operating manuals (OM's)
- System Routine Tests.
- Control Room Master Flowsheets.

b) Maintenance documentation, medium quality information:

- Control and Mechanical Maintenance Procedures (CMP's and MMP's).
- Manufacturer's manuals and other vendor information.
- Calibration Records.

c) Design related information, medium quality information:

- Drawings, technical specifications, and other design related information.

d) Computerized information:

- Work Management System.

5.3 Calibration Data Requirements

a) Data validity: the calibration data is checked for validity based on OP&P, Design and manufacturers information;

b) Data completeness: All instruments have calibration sheets, each calibration sheet has a minimum of five point calibration specifications and Input/Output tolerances.

c) Calibration techniques for generic instruments on each loop have been reviewed.

5.4 Error Analysis:

The objective of initiating an error analysis for each instrument loop being considered is to derive loop uncertainty, and, if available to obtain instrument drift error. The error analysis is done with the following general assumptions:

a) Adverse effects of environmental conditions on instrument performance are not included.

b) Adverse effects of power supply irregularities are not included;

c) The tolerance applied to instrument calibration over the entire range is the maximum error calculated within the range.

d) Error and uncertainties are considered to be random with a normal distribution. They are combined using the sum of squares (RSS) to give the limit of the result 95% of the time.

e) Errors due to installation are not included.

f) Transmitter calibration specification is defined as only in the direction of the associated loop alarms.

6.0 Conclusion

A strategy has been developed and is systematically applied to achieve the objectives pertaining to each Phase of the strategy. This strategy ensures that:

i) for each system under consideration, all instrument loops have been identified; all instruments have been identified and; all calibration data requirements have been satisfied;

ii) for each loop, the requirements of all elements that require calibration have been considered and documented; (i.e. licensing, economic, etc.)

iii) the status of calibration processes has been documented and identified;

iv) all gaps have been identified and action has been initiated to correct any deficiencies and/or close any gaps on the calibration program.

v) the calibration tolerance(s) and the loop error(s) are analyzed to ensure the instrument loops will be calibrated within their allowed limits.

vi) all the calibration program deficiencies are identified and resolved.

vii) the System Responsible Engineer (SRE) and the Design Responsible Engineer (DRE) are provided with a surveillance tool to monitor the performance and the health of his/her systems.